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INTERFACE SPECIFICATION
RF DATA TRANSMISSION INTERFACES
FOR
DOD PHYSICAL SECURITY SYSTEMS

Reviewed by: The Security Equipment
Integration Working Group (SEIWG) at Ft. McClellan, AL
8/9 December 1981

Approved by
Major Gary Seasholtz, USAF
Chairman - SEIWG
15 December 1981

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1.0 SCOPE.

This specification is one of a series of specifications which document the established interfaces between DOD physical security system equipment items. It has been prepared under the auspices of DOD Directive 3224.3 and is maintained under the control of the Security Equipment Integration Working Group (SEIWG). References to the Base and Installation Security System (BISS) contained herein are not to be interpreted as limiting the application of this specification to a single service's security system, but rather to address the architectural aspects of BISS which are presented in BIS-SYS-10000 and which are intended to be applicable to the physical security systems of all DOD components. The purpose of this specificaton is to define the interface requirements between the RF Data Transmission System and the Physical Security Intrusion Detection Systems being developed by the agencies identified in 1.2.1.

1.1 Item description. The RF Data Transmission System equipment consists of the RF receiver, RF transmitter, RF interference cancellation system (ICS) and the RF repeater. Physical Security Intrusion Detection Systems consist of one or more types of intrusion detection sensors to provide intrusion alarm data over appropriate communication links to one or more operator control/displays. The operator control/displays are normally located apart from the sensors and, as in the case of large military bases, these distances can vary in terms of miles. Sensor alarm data from one or more sensors is normally routed to an intrusion zone collector/control unit and transmitted via hardwire (twisted pair or telephone line) data links to one or more appropriate receiving units for processing and display to the operator(s). The RF Data Transmission System provides an alternate communications link between remote sensors and signal processing and control/display equipments to the normal hardwire communications links. For some applications the RF means of communication will be the only data link available or feasible. This specification is limited to the interface between the Intrusion Detection System and the RF Data Transmission System. Specific equipment configurations and deployment capabilities are addressed by the applicable system/equipment specifications hence not repeated herein.

1.2 Contractors. This specification will be provided as required to contractors who become involved in the development of DOD physical security equipment, by the respective developing/acquiring activity.

1.2.1 Developing agencies. The following agencies are responsible for the development of security systems relating to these specifications:

a. The Facility Intrusion Detection System (FIDS) is being developed by the U.S. Army Counter-Intrusion Laboratories, USAMERADCOM, (DRDME-XI), Ft. Belvoir, VA, 22060.

b. The Base and Installation Security System (BISS) is being developed by the U.S. Air Force Physical Security Systems Directorate, Hq. ESD(OCB), L.G. Hanscom AFB, MA, 01731.

c. The Remotely Monitored Battlefield Sensor System (REMBASS) is being developed by the U.S. Army Electronics Research and Development Command, USAERADCOM, (DRCPM-FFR-TM) Ft. Monmouth, NJ, 07703.

2.0 APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS:

Federal:

None

Military:

None

Other Government Activity:

SEIWG-002	15 APR 81 (Draft)	Interface Specification Collector (Transmitter) /Communication Functional Areas for the Base and Installation Security System (BISS) (BISS-INF-10102)
SEIWG-004	15 MAY 81 (Draft)	Interface Specification Control Unit/Line Control Processor for DoD Physical Security Systems
RAWS-001	19 May 78	ERADCOM Development Specification, Remote Automatic Weather Station (RAWS) System (Met Station, Automatic, AN/TMQ-30)
RBS-001A (Addendum 3)	16 Jan 81	REMBASS Specification: "RF Data Link Interoperability Specification"

STANDARDS:

Federal:

None

Military:

MIL-STD-188-100	15 NOV 72	Common Long Haul and Tactical Communication System Technical Standards
Notice 1	16 JUL 75	
Notice 2	1 JUN 76	
Notice 3	17 NOV 76	
MIL-STD-189	15 NOV 55	Racks, Electrical Equipment, 19-Inch and Associated Panels
Notice 2	14 MAR 61	
MIL-STD-454G	15 MAR 80	Standard General Requirements for Electronic Equipment.

Other Government Activity:

None

DRAWINGS:

None

OTHER PUBLICATIONS:

Manuals:

None

Regulations:

None

Handbooks:

None

DIRECTIVES:

DOD Dir 3224.3	1 December 1976	Physical Security Equipment; Assigment of Responsibility for Research, Engineering Procurement, Installation and Maintenance

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the acquiring activity or as directed by the contracting officer.)

2.2 Non-government documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS:

None

STANDARDS:

EIA STANDARD RS-422A	Dec 78	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA STANDARD RS-423A	Dec 78	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits

(Available from Electronic Industries Association, Engineering Department, 2001 Eye Street, N.W., Washington, DC 20006)

3.0 INTERFACE REQUIREMENTS

Figure 1 shows the Intrusion Detection System/RF Data Transmission System external interfaces addressed by this specification.

3.1 Physical. The physical (mechanical) interface between the RF Data Transmission System equipment and the affected Intrusion Detection System shall be in accordance with the following constraints.

3.1.1 Electrical connectors. Electrical interface connection shall be accomplished at the external interface connectors provided by the RF Data Transmission System hardware. The external interface connectors shall be selected in accordance with MIL-STD-454, Requirement 10. The affected Intrusion Detection System shall furnish the appropriate external interface mating connector(s). Connectors requiring the use of potting compound materials shall be avoided.

3.1.2 Interface cables. Interface cables shall be terminated at the RF Data Transmission System with an appropriate mating connector and shall be in accordance with MIL-STD-454, Requirement 71.

3.1.3 Electrical equipment cabinet/panel interface. For applications where the RF Data Transmission System equipment will be rack mounted the affected Intrusion Detection System shall provide the electrical equipment cabinet which will accommodate the RF Data Transmission System equipment panels. The electrical equipment cabinet/panel interface shall be in accordance with MIL-STD-189.

3.2 Functional.

3.2.1 Electronic. All data interchange, timing, and control circuits between the RF Data Transmission System and the Intrusion Detection System shall be in accordance with EIA Standard RS-422A, Electrical Characteristics of Balanced Voltage Digital Circuits or EIA Standard RS-423A, Electrical Characteristics of Unbalanced Voltage Digital Circuits. All such inputs and outputs shall be balanced or shall be unbalanced, as selected by the installer via a single switch or strap or by using different connector pins, etc. Definitions of binary one and binary zero are as given in the applicable cited standard.

3.2.1.1 RF Transmitter interface signals. Figure 2 shows the RF transmitter interface signals and their timing relationship to each other and the RF power output level.

3.2.1.1.1 Request to Send (RTS). The RTS Command shall be a logic level and shall control the amplification (RF Power ON)/non-amplification (RF Power OFF) of the transmitter RF signal. An RTS command (RF power ON) shall be a binary zero. An RF Power OFF command shall be a binary one. The RTS (RF Power ON) command must remain ON (binary zero) as long as RF power is required.

3.2.1.1.2 TX Carrier Detected ON. The Tx Carrier Detected ON signal shall be a logic level. This signal shall be binary zero (Tx Carrier ON) whenever the transmitter RF carrier output reaches or exceeds 90% of the rated output and shall be binary one whenever the RF carrier output falls to less than 90% of rated output.

3.2.1.1.3 Serial data. The data message inputted to the RF transmitter for modulation of the RF carrier shall be binary, bi-phase (Manchester), coded at an information bit rate of 1200 $\pm$ 36 bits per second. The coding shall be such that a transition from binary zero (mark) to binary one (space) in the middle of a bit period is defined as a logical "1"; conversely a transition from binary one (space) to binary zero (mark) in the middle of the bit period is defined as logical "0". The first transmitted zero of the message preamble shall not be sent to the transmitter prior to the Tx Carrier Detected ON signal going ON (binary zero).

3.2.1.2 RF Receiver interface signals. Figure 3 shows the RF receiver interface signals and their timing relationships to each other.

3.2.1.2.1 Receive Carrier Detected. The Receive Carrier Detected signal shall be a logic level. This signal shall be ON (binary zero) whenever the received RF is of sufficient magnitude to exceed a preset quieting threshold. It shall be OFF (binary one) at all other times.

3.2.1.2.2 Data Present. The Data Present signal shall be a logic level. This signal shall be ON (binary zero) whenever the received RF is of sufficient magnitude to exceed a preset quieting threshold and at least 5 sequential correctly positioned zeros at a 1200 $\pm$ 36 bit per second rate have been detected. It shall remain ON (binary zero) for the length of the message, as determined by the detector. This signal shall be OFF (binary one) at all other times.

3.2.1.2.3 NRZ data. The NRZ data output signal shall be binary coded at an information bit rate of 1200 $\pm$ 36 bits per second.

3.2.1.2.4 NRZ clock. The NRZ clock shall be 1200 $\pm$ 36 bits per second. The clock-data relationship shall be per MIL-STD-188-100.

3.2.1.2.5 Delayed Manchester data. The delayed Manchester data (reformatted Manchester data which includes a regenerated preamble) shall be binary, bi-phase (Manchester) coded at an information bit rate of 1200 $\pm$ 36 bits per second. The delayed Manchester data shall be outputted upon detection of the first "1" (start bit) following receipt of five (5) or more correctly positioned zeros.

3.2.1.2.6 Data Inhibit. The Data Inhibit command, when extended to the receiver, shall control the state of the NRZ Data driver line. A binary zero logic level shall cause the the NRZ Data line driver to assume a high impedance (tri-stated) condition and the respective receiver baseband data outputs shall be inhibited. A binary one (Data Inhibit OFF) logic level shall cause the NRZ Data line driver output to assume low impedence state, allowing data to be sent out. When the Data Inhibit control line is not connected to the receiver, the NRZ Data line driver shall be as if a binary one (Data Inhibit OFF) logic level is applied via this control line.

3.2.1.3 RF characteristics.

3.2.1.3.1 RF system band. The RF tuning range over which the receiver and transmitter may be operated shall be from 138 MHz to 153 MHz.

3.2.1.3.2 On/Off switching times. The time for the transmitter to reach 90% of peak power and to be within the steady-state space frequency tolerance after the RTS (RF Power ON) command shall be 0.5 ms minimum and 2 ms maximum. Transmitter power shall fall to below 10% of peak power within 2 milliseconds after RF Power OFF (RTS to binary one).

3.2.1.3.3 Long term stability. Long term stability is the maximum allowable deviation or shift of the carrier frequency from the specified channel center frequency as measured over a long period. Long term stability shall not exceed $\pm$ 10 parts per million when measured over a six month duration.

3.2.1.3.4 Short term stability. The carrier frequency shall not vary more than 2 parts per million after the RF power has reached 90% of its peak value measured over a 30-second period.

3.2.1.3.5 Channel description (See Figure 4). The RF Data Link channel is a 25KHz frequency range about a specifically assigned center frequency, and an associated channel number from 1 to 599, over which a message (information) is transferred. The channel bandwidth includes a guard band, an information band, and sufficient bandwidth to accomodate the carrier frequency uncertainty due to transmitter and receiver instability. Channel bandwidth shall be 25 KHz. Channel 1 center frequency (f_c) shall be 138.025 MHz; Channel 2 shall be 138.050 MHz, etc., and Channel 599, the last channel, shall be 152.975 MHz.

3.2.1.3.5.1 Information band. Information band is the part of a channel which is used for information transmission. Information band shall not exceed 16.8 KHz at the 3 dB points (fc $\pm$ 8.4 KHz).

3.2.1.3.5.2 Guard band. Guard band is that part of a channel not used for information transfer to allow for operation on adjacent channels. The guard band shall be centered midway between adjacent channels. It shall be at least 4 KHz wide when measured 65 dB down from the transmitted signal level. (See Figure 4.)

3.2.1.3.6 Polarization. The transmitted signal shall be vertically polarized.

3.2.1.3.7 Modulation. The method used by the transmitter to modulate the RF carrier fc shall be binary, frequency shift keying (FSK) where fc $+\Delta f$ and fc $-\Delta f$ shall designate "mark" and "space" frequencies, respectively. The steady state Δf shall be 3.0 KHz $\pm$ 300 Hz (See Figure 5). The receiver, however, shall be capable of receiving FSK signals with steady state Δf of 3.0 $KH_z \pm 600H_z$. It should be noted that the use of the terms "mark" and "space" in this specfication does not conform with the more conventional meaning. Information is contained in the frequency transition from mark-to-space and space-to-mark rather than the space or mark frequencies. The scheme used is called Manchester Biphase.

3.2.1.3.7.1 Manchester Biphase coding. Manchester Biphase coding shall be used to transmit information. Figure 6 shows that the frequency transition, which occurs in the center of all bit periods, determines the bit value. A transition from "mark" to space" in the middle of a bit period is defined as a logical "1"; conversely, a transition from "space" to "mark" is defined as logical "0". The convention will be that a more positive input voltage will be associated with (fc + Δf).

3.2.1.3.7.2 Message bit rate. The message bit rate shall be 1200 $\pm$ 36 bps.

3.2.1.3.7.3 Incidental deviation. Incidental deviation is the spurious deviation with no modulation input. Incidental deviation shall be less than 60 Hz.

3.2.1.3.7.4 Overshoot. The receiver shall be able to receive FSK signals with a leading edge transient overshoot of the mark-to-space or space-to-mark frequencies. The overshoot deviation shall not exceed $+300H_Z-0H_Z$ of the steady state excursion of the received Δf.

3.2.1.3.7.5 Mark-Space transition time. Mark-to-space and space-to-mark transition times shall be 75 microseconds minimum to 125 microseconds maximum.

3.2.1.3.8 Message recognition formats.

3.2.1.3.8.1 Preamble. DoD Physical Security System RF transmitted messages shall have a common preamble (message bits 1-9). The entire preamble sequence shall be eight "zeros" followed by a "one". A logical "one" received following the detection of the minimal fragment of the preamble (five or more sequential zeros that occur at bit rate intervals) is deemed to be the start bit, (message bit 9).

3.2.1.3.8.2 Message code field. All DoD Physical Security Systems RF transmitted messages have a message code field (message bits 10-13). Table I identifies the assignments made to date. These bits allow individual users to uniquely select messages desired. In addition, these bits may also be used for additional functions if deemed appropriate. In Table I, message bits 10-13 are denoted by M_0, M_1, M_2, M_3 where M_0 is the bit transmitted first.

3.2.1.3.8.3 Message data fields. Starting with message bit 14 and beyond, the bit assignments are unique to the individual users. BISS and REMBASS have traditionally used a 29 bit digital message. The FIDS message is made up of varying numbers of 11 bit bytes, following eight (8) or more zeros. The first byte of a FIDS message incorporates the start bit (bit 9) and the Message Code field (bits 10-13). However, message length is not restricted by this document. The actual bit assignments for each message code assigned are provided in applicable documents (See Table I). These are SEIWG documents that are under SEIWG configuration management control.

3.2.2 Electrical. The RF Data Transmission System shall be capable of operation when supplied with any one of the following prime power inputs by the Intrusion Detection System.

3.2.2.1 AC Power.

a. Voltage: 115/208 Vac, ± 10%

b. Frequency: 48 to 63 Hertz

c. Phase: One phase, 3 wire

d. Power: 35 Volt-Amps (Transmitter)
1 Volt-Amp (Receiver)
1 Volt-Amp (ICS)

3.2.2.2 +24 Vdc Power. (Not available in AD)

a. Voltage: +24 Vdc, +8, -4 Vdc

b. Current: 1.25 amperes (Transmitter)
20 milliamperes (Receiver)
30 milliamperes (ICS)

3.2.2.3 +12 Vdc Power.

a. Voltage: +12 Vdc ± 10%

b. Current: 2.5 amperes (Transmitter)
40 milliamperes (Receiver)
60 milliamperes (ICS)

4.0 QUALITY ASSURANCE PROVISIONS

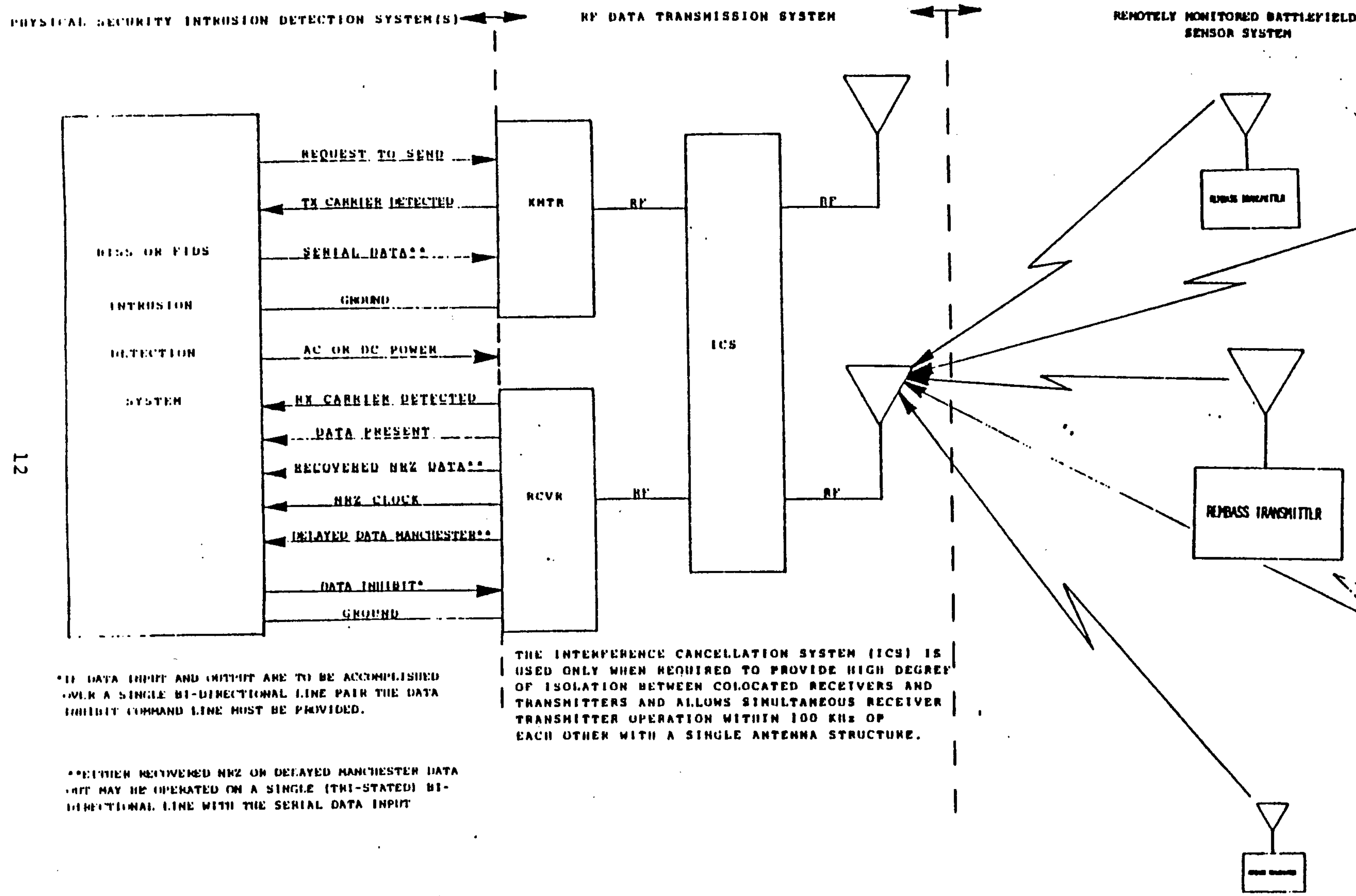
Inspection and test requirements to verify hardware and/or software compliance with the specified interface requirements of Section 3 shall be included in specifications of those interdependent systems, subsystems, components and equipments which use the interface specified herein.

5.0 NOTES

5.1 Specification custodian. The Physical Security Systems Directorate (PSSD), has been designated as custodian of this specification. Appropriate comments, questions and suggested changes should be forwarded to Hq. ESD/OCBR, LG Hanscom AFB, MA, 01730 for resolution or referral to the Security Equipment Intergration Working Group.

1 2 3 4 5 6 7 8	9	10 11 12 13	14 15 16 … N	
PREAMBLE		MESSAGE CODE	DATA	MESSAGE LENGTH (N)
	START			
0 0 0 0 0 0 0 0	1	M_0 M_1 M_2 M_3	(See cited applicable specification for definition of bit assignments.)	
BISS:			SEIWG-002	
ALARM		1 0 1 0		29 Bits
SUPERVISION		1 1 0 0		29 Bits
SELF TEST		0 1 0 1		29 Bits
REMBASS:			RBS 001A (Addendum 3)	
CLASSIFICATION		0 1 1 0		29 Bits
ANALOG		1 0 1 1		29 Bits plus 15 sec. audio
COMMAND		1 0 0 1	To be specified	TBD
DIGITIZED IMAGE		1 0 0 0		TBD
FIDS:			SEIWG-004	
THREE BYTES		0 0 0 0		41 Bits
FIVE BYTES		0 0 0 1		63 Bits
SEVEN BYTES		0 0 1 0		85 Bits
NINE BYTES		0 1 0 0		107 Bits
SYNCHRONIZATION		1 1 1 0		63 Bits
OTHERS:				
RAWS		0 0 1 1	RAWS-001	101 Bits
TO BE ASSIGNED		0 1 1 1	To be specified	TBD
		1 1 0 1		TBD
		1 1 1 1		TBD

TABLE 1 MESSAGE RECOGNITION FORMAT

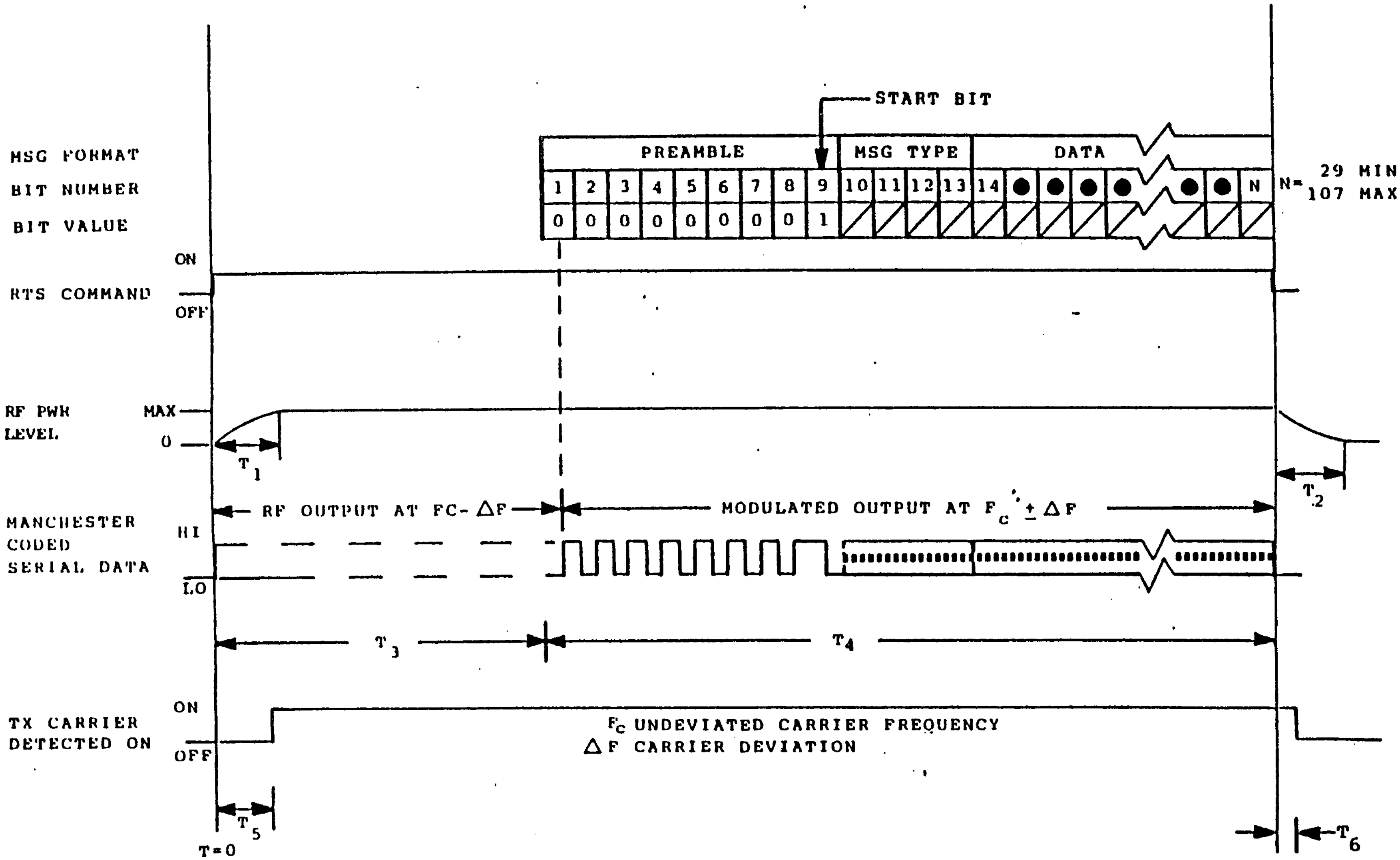


*IF DATA INPUT AND OUTPUT ARE TO BE ACCOMPLISHED OVER A SINGLE BI-DIRECTIONAL LINE PAIR THE DATA INHIBIT COMMAND LINE MUST BE PROVIDED.

**EITHER RECOVERED NRZ OR DELAYED MANCHESTER DATA OUT MAY BE OPERATED ON A SINGLE (TRI-STATED) BI-DIRECTIONAL LINE WITH THE SERIAL DATA INPUT

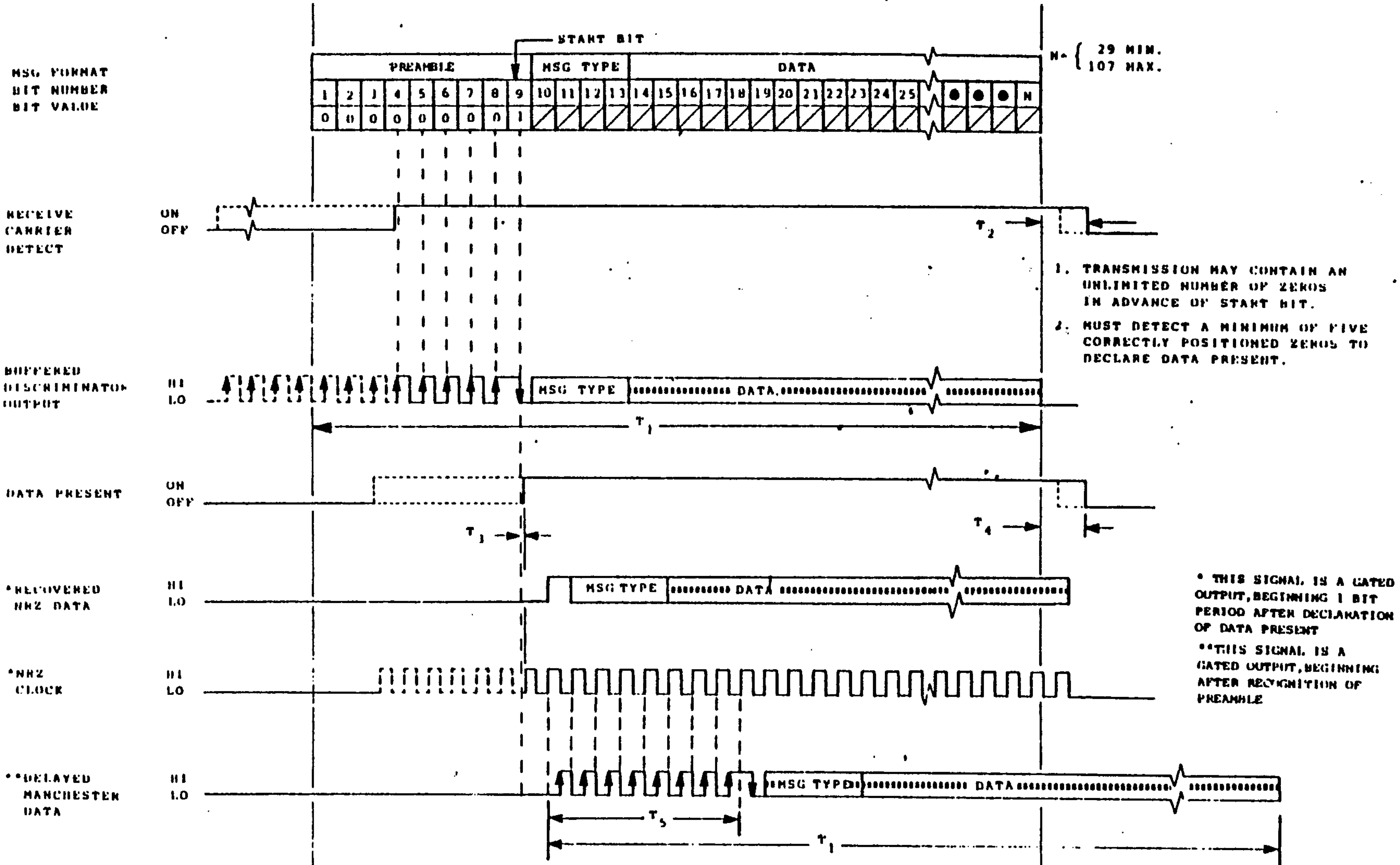
THE INTERFERENCE CANCELLATION SYSTEM (ICS) IS USED ONLY WHEN REQUIRED TO PROVIDE HIGH DEGREE OF ISOLATION BETWEEN COLOCATED RECEIVERS AND TRANSMITTERS AND ALLOWS SIMULTANEOUS RECEIVER TRANSMITTER OPERATION WITHIN 100 KHz OF EACH OTHER WITH A SINGLE ANTENNA STRUCTURE.

FIGURE 1. INTRUSION DETECTION SYSTEM/RF DATA TRANSMISSION SYSTEM INTERFACE.



T_1 0.5 MS MIN TO 2.0 MS MAX TO ACHIEVE 90% OF RF PWR OUTPUT
T_2 0.5 MS MIN TO 2.0 MS MAX TO FALL BELOW 10% OF RF PWR OUTPUT
T_3 FIRST ZERO OF PREAMBLE WITHHELD UNTIL RECEIPT OF TX CARRIER DETECTED ON
T_4 N BITS X 833 MICROSECONDS (NOMINAL)
T_5 VARIES WITH RF PWR LEVEL $\leq$ 2 MS
T_6 VARIES WITH RF PWR LEVEL $\leq$ 2 MS

FIGURE 2, RF TRANSMITTER SIGNAL TIMING



T_1 N BITS X 833 MICROSECONDS (NOMINAL)

T_2 DETERMINED BY TRANSMITTER. NORMALLY ≤ 2 msec.

T_3 DATA DETECTION SYSTEM DESIGN DELAY

T_4 APPROXIMATELY 1½ BIT PERIODS.

T_5 8 BITS X 833 MICROSECONDS (NOMINAL)

FIGURE 3. RF RECIEVER SIGNAL TIMING

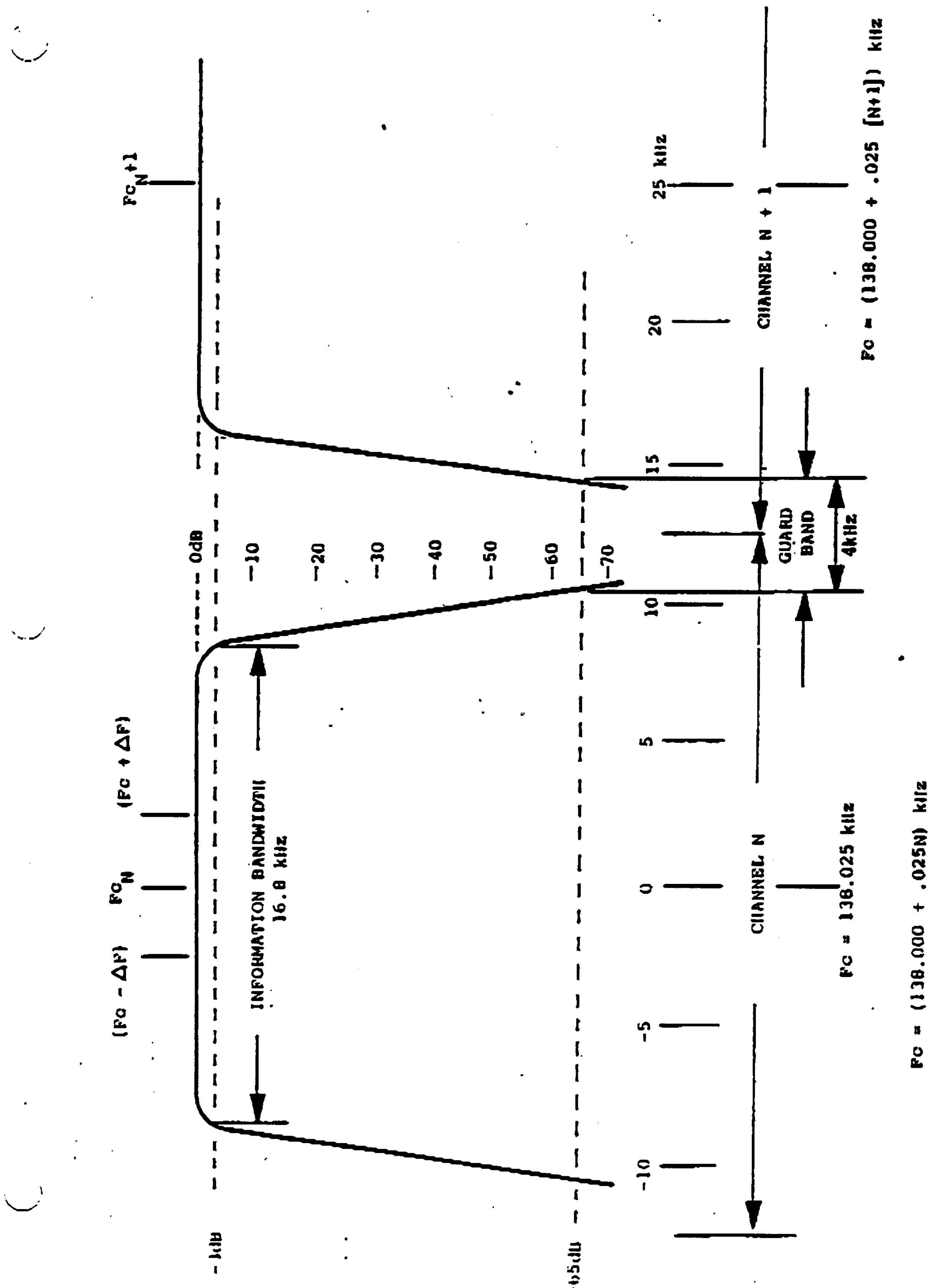


FIGURE 4 CHANNEL DESCRIPTION

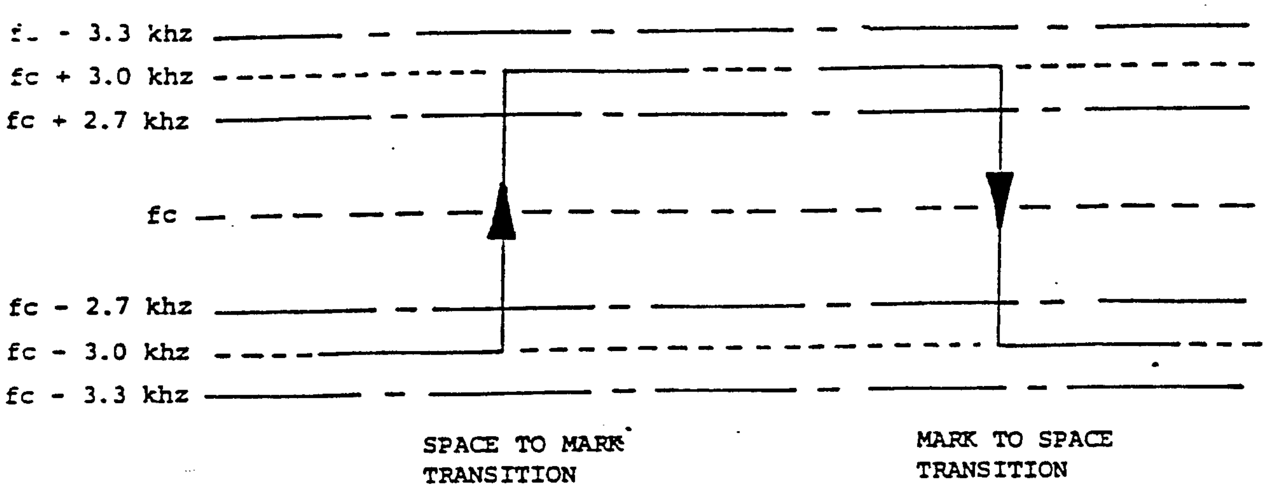


FIGURE 5 TRANSMITTER FSU MODULATION

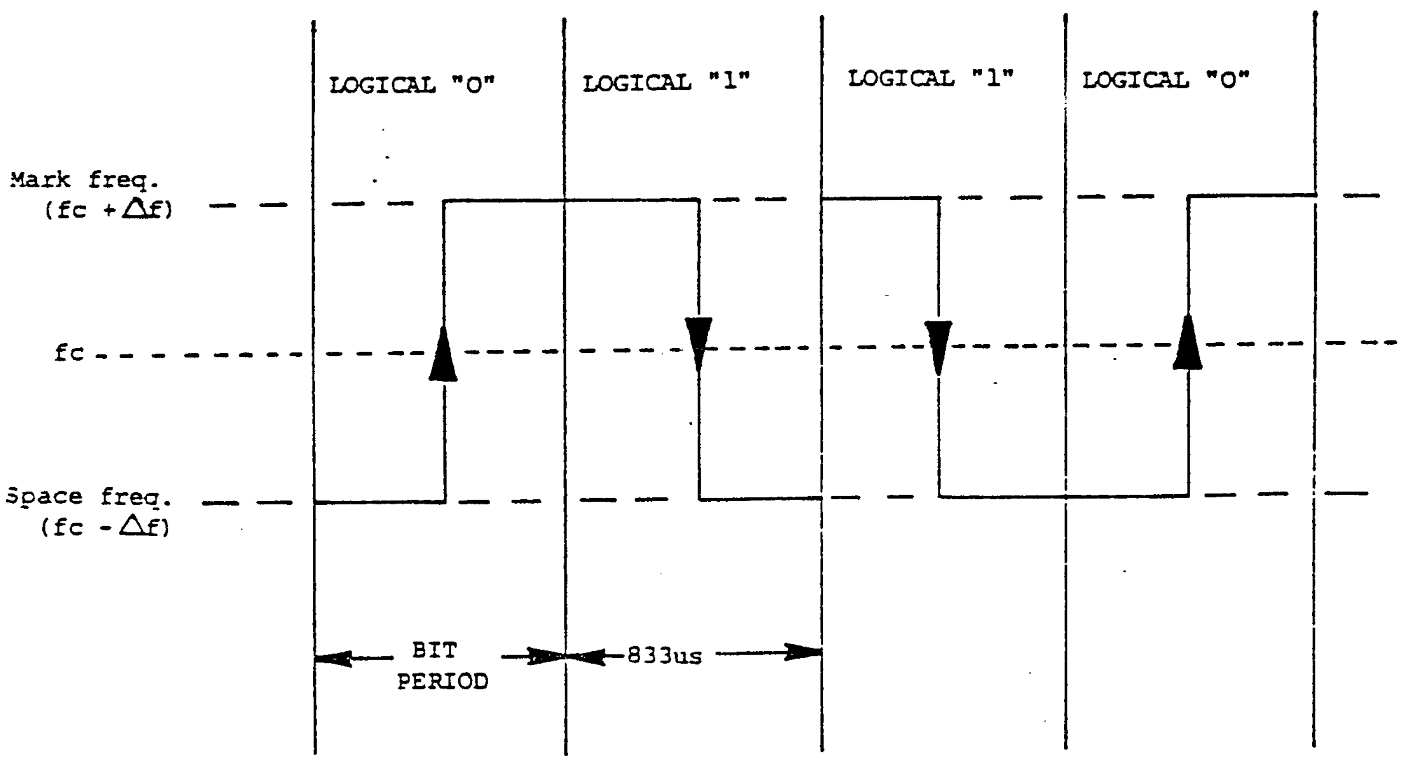


FIGURE 6 MANCHESTER CODING